

## INTERPRETIVE STRUCTURAL MODELING APPLY TO PATIENT SAFETY CULTURE

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### ABSTRACT

#### AIM

*Interpretive Structural Modeling (ISM) has established a structure of hierarchy element by Warfield in 1973. In the field of the ISM system, to represent in a complex pattern of conceptual structure as a graphically variable relationship, which were simple to be understood than in a textual narratives format. Thus, the ISM is a method of perfecting the relationship between variables, that has identify a particular project problem or issue. The aim of this study is to apply ISM to guide healthcare decision makers to establish and to promote patient safety culture activities in healthcare settings.*

#### METHOD

*This study has identified the interpretation structural model process in Safety Attitudes Questionnaire (SAQ), which has divided into six domains of patient safety culture. Through the correlation of six domains variables, which has set up the adjacent matrix and reachability matrix, finally explanatory structural hierarchy variable model were established.*

#### RESULTS

*1. Among correlations between of six domain of variables, "teamwork climate" has influenced "safety climate", "job satisfaction", " stress recognition ", " perceptions of management " and " working conditions ".*

*2. Teamwork climate as the first layer of ISM, perceptions of management as second layer, working conditions as third layer, job satisfaction as fourth layer, stress recognition as fifth layer, and safety climate as sixth layer.*

#### CONCLUSIONS

*Interpretive Structural Model has assisted healthcare decision maker to address and implement as the first priority in promoting patient safety culture, in contributes to implement of a safe atmosphere to improve patient safety in healthcare settings.*

**KEYWORDS:** Interpretative Structural Modeling, Patient Safety Culture & Healthcare

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## INTRODUCTION

Interpretive Structural Modeling (ISM) has established a structure of hierarchy element by Warfield in 1973. In the field of the ISM system, to represent in a complex pattern of conceptual structure as a graphically variable relationship, which were simple to be understood than in a textual narratives format (Singh, Shankar, Narain and Agarwal, 2003; Ravi and Shankar, 2005; Faisal, Banwet, and Shankar, 2006). Thus, the ISM is a method of perfecting the relationship between variables that identify a particular project problem or issue (Jharkharia S. and Shankar R. 2005).

Take the safety culture of hospital patients as an example, Patient safety issues are considered a global medical care problem (Patel and Wu, 2014). Not only is considered to be the core element of the promotion of medical quality and safety (Hamdan, 2013), At the same time, it is also an important issue in reducing medical malpractice and improving patient safety (Kaya, Barsbay, and Karabulut, 2010; Poley, van der Starre, van den Bos, van Dijk, and Tibboel, 2011). Patient safety culture is part of the organizational culture, safety culture survey can help medical care institutions to understand the safety of patients, through the measurement of the questionnaire, that the organization's safety culture.

Questionnaire in measuring of patient safety culture is the Safety Attitude Questionnaire (SAQ) (Kaya et al., 2010), which includes teamwork climate, safety climate, job satisfaction, management, working conditions and stress cognition six facets (Kaya et al., 2010). In considering the complex relationship between organizational securities cultural attitudes, how to more accurate describe the direct and indirect relationship between the six facets variables not an independent factor. Therefore, the purpose of this study is to apply the interpretation of ISM to promote the safety of cultural activities of patients as an empirical study, draw a hierarchy of affiliation help to hospital decision makers to establish and promote patient safety culture activities in prior sequence.

## METHODS

This study has identified the interpretation structural model process in Safety Attitudes Questionnaire (SAQ), which has divided into six domains of patient safety culture. Through the correlation of six domains variables, which has set up the adjacent matrix and reachability matrix, finally explanatory structural hierarchy variable model were established.

ISM operation process is structured as five sections:

**Step 1:** Directed graph

**Step 2:** Binary matrix representation (adjacency matrix)

**Step 3:** Element connection matrix

**Step 4:** Reachability matrix

**Step 5:** Hierarchy graph

### Application of Panel Data Analysis

The questionnaire was designed for hospital organizations to promote patient safety activities experts to answer the questionnaire.

Step 1 by Expert on the Safety Attitude Questionnaire (SAQ) in establishing a relationship between the six areas of the patient safety culture. Confirm the relationship between two binary variables in the components of the system

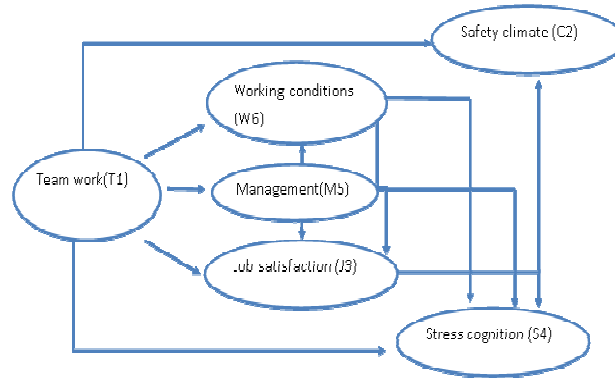


Figure 1

T1RC2, T1RJ3, T1RS4, T1RM5, T1RW6, J3RC2, J3RS4, S4RC2, M5RJ3, M5RS4, M5RW6, W6RJ3, W6RS4 (Notice: T1RC2 is the variables team work (T1) and safety climate (C2) are related)

**Step 2 Binary Matrix Representation (Adjacency Matrix):** The binary elements of the components within the system placed in the matrix, the two pairs of comparison, if the relationship is written as 1, no relationship was 0.

$$A = [a_{ij}]_{n \times n} \quad a_{ij} = \begin{cases} 1, & \text{if } i \text{ for } j \text{ impact} \\ 0, & \text{if } i \text{ for } j \text{ no impact} \end{cases}$$

$$A = \begin{matrix} & \begin{matrix} T1 & C2 & J3 & S4 & M5 & W6 \end{matrix} \\ \begin{matrix} T1 \\ C2 \\ J3 \\ S4 \\ M5 \\ W6 \end{matrix} & \begin{pmatrix} 0 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 0 & 0 \end{pmatrix} \end{matrix}$$

Figure 2: Adjacency Matrix

**Step 3 Element Connection Matrix:** The adjacent matrix A and the unit matrix I are added to become the element connection matrix B Figure 3 Element connection matrix

$$A = \begin{matrix} & \begin{matrix} T1 & C2 & J3 & S4 & M5 & W6 \end{matrix} \\ \begin{matrix} T1 \\ C2 \\ J3 \\ S4 \\ M5 \\ W6 \end{matrix} & \begin{pmatrix} 0 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 0 & 0 \end{pmatrix} \end{matrix}$$

(Adjacent matrix)

$$\begin{aligned}
 I = & \text{(Identity matrix)} \\
 & \begin{matrix} & \begin{matrix} T1 & C2 & J3 & S4 & M5 & W6 \end{matrix} \\ \begin{matrix} T1 \\ C2 \\ J3 \\ S4 \\ M5 \\ W6 \end{matrix} & \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix} \end{matrix} \\
 \\
 B = & \text{(Element connection Matrix)} \\
 & \begin{matrix} & \begin{matrix} T1 & C2 & J3 & S4 & M5 & W6 \end{matrix} \\ \begin{matrix} T1 \\ C2 \\ J3 \\ S4 \\ M5 \\ W6 \end{matrix} & \begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 0 & 1 \end{pmatrix} \end{matrix}
 \end{aligned}$$

Figure 3: Element Connection Matrix

**Step 4 Reachability Matrix:** Calculate the power matrix using Boolean algebra ( $0+0=0$ ,  $0+1=1$ ,  $1+1=1$ ;  $0 \times 0=0$ ,  $0 \times 1=0$ ,  $1 \times 1=1$ ). To achieve convergence get reachability matrix (Figure 4)

$$\begin{aligned}
 R(B3) = & \text{(Reachability matrix)} \\
 & \begin{matrix} & \begin{matrix} T1 & C2 & J3 & S4 & M5 & W6 \end{matrix} \\ \begin{matrix} T1 \\ C2 \\ J3 \\ S4 \\ M5 \\ W6 \end{matrix} & \begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 0 & 1 \end{pmatrix} \end{matrix}
 \end{aligned}$$

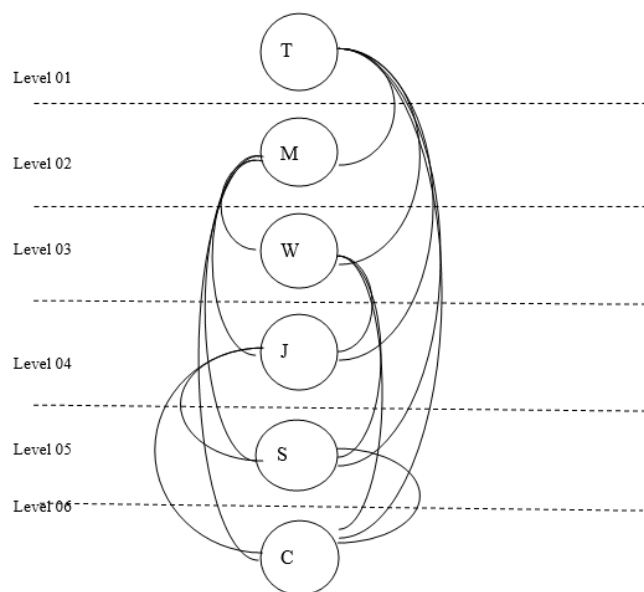
Figure 4: Reachability Matrix

**Step 5 Hierarchy Graph:** Hierarchy graph construction is that all level of Variables are determined on the basis of intersection of reachability set and intersection set. Calculate Conical Matrix from the Reachability Matrix in order to surface direct relationships between elements.

Level of Variables				
Variable	Reachability Set	Antecedent set	Intersection Set	Level
T1	T1, C2, J3, S4, M5, W6	T1	T1	VI
C2	C2	T1, C2, J3, S4, M5, W6	C2	I
J3	C2, J3, S4	T1, J3, M5, W6	J3	III
S4	C2, S4	T1, J3, S4, M5, W6	S4	II
M5	C2, J3, S4, M5, W6	T1, M5	M5	V
W6	C2, J3, S4, W6	T1, M5, W6	W6	IV

$$R = \begin{matrix} & \begin{matrix} C2 & S4 & J3 & W6 & M5 & T1 \end{matrix} \\ \begin{matrix} C2 \\ S4 \\ J3 \\ W6 \\ M5 \\ T1 \end{matrix} & \begin{pmatrix} 1 & & & & & \\ 1 & 1 & & & & \\ 1 & 1 & 1 & & & \\ 1 & 1 & 1 & 1 & & \\ 1 & 1 & 1 & 1 & 1 & \\ 1 & 1 & 1 & 1 & 1 & 1 \end{pmatrix} \end{matrix}$$

Finally draw a hierarchy diagram. (Figure 5).



**Figure 5: Patient Safety Culture of Hierarchy Graph**

## CONCLUSIONS

In the six dimensions of the patient's safety culture to promote, the ISM graphical representation allows the manager to better understand the priority of the patient's safety culture. ISM has identified in six layers of patient safety management, which consisted in teamwork climate as first layer, perceptions of management as second layer, working condition as third layer, job satisfaction as fourth layer, stress recognition as fifth layer, and safety climate as sixth layer.

The interpretive structural modeling (ISM) is a visual expression to study complex structural problems. ISM only consider the direct binary relationship between variables (0 and 1), so only consider the direct impact of the two factors, and can only see the impact or no impact, cannot see the relationship between the degrees of strength. According to Duperrin & Godet (1973) Concept of Impact Matrix Cross Reference Multiplication Applied in a Classification (MICMAC) method could be further applied in the future. Not only taking into account the direct relationship and indirect relationship, taking into account the strength of the relationship between the factors and the influence of factors on the system.

Improving teamwork climate is the most essential element in promoting of patient safety culture in a healthcare system, which needs to be addressed for healthcare worker in first priority; moreover, other dimension of safety climate factors will be necessary in contributes to the implementation of a safe atmosphere to improve the overall safety for the patient.

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